MINIOPD EXP - OPD EXP
BRAKING UNIT
USER'S MANUAL

EN

BLU

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1 GENERAL DESCRIPTION

This braking module (BRU), along with its braking resistor, is used to limit the DC BUS voltage when power is supplied by a generator, if the line input stage is unable to feed the field power back into the line. This occurs when the input stage consists of a rectifier bridge or a regenerative unit (AFE – Active front End) which goes into current limit, or when line regeneration is disabled.
During this operation, the power supplied by the DC BUS (intermediate circuit) is converted into heat dissipated in the external braking resistor.
The braking module can work as an independent unit or can be controlled by an external smart unit.
It is also possible to use several braking modules connected in parallel, each with its own external braking resistor.

2 USE LIMITATIONS

The environmental limitations to the use of the braking module under normal operating conditions are described hereinafter.

2.1 CLIMATIC CLASS

Class 3K3 ACCORDING TO EN 60721-3-3

Environmental Parameter	Limits	Unit of measurement
operating temperature (1)	0÷40	°C
humidity	5÷85	%
atmospheric pressure	70÷106 (2)	kPa
maximum surrounding air velocity	1	m/s
maximum temperature gradient	0.5	°C/min
maximum thermal radiation	700	W/m^2
condensation	NO	
precipitation with wind	NO (3)	
water other than rain	NO	
ice formation	NO	

Table 1

(1) Climatic Class 3K3 envisages a 5÷40°C use limitation; however, the converter can work at a room temperature as low as 0°C. The maximum operating temperature of the converter reaches 45°C without output thermal current derating.
(2) The atmospheric pressure limitations correspond to an operating range of 0÷3000m above sea level. At altitudes exceeding 1000 m a.s.l., the rated power of the Braking Unit must be derated by 1% every 100m.
(3) The converter must be installed inside a cabinet (never install it outside).

2.2 RESISTANCE TO CHEMICALLY ACTIVE SUBSTANCES

Class 3C1R according to EN 60721-3-3

Environmental parameter	Maximum value	Unit of measurement
sea salts	NO	-
sulphur dioxide	0,01	mg/m^3
	0,0037	cm^3/m^3
hydrogen sulphide	0,0015	mg/m^3
	0,001	cm^3/m^3
chlorine	0,001	mg/m^3
	0,00034	cm^3/m^3
hydrochloric acid	0,001	mg/m^3
	0,00066	cm^3/m^3

Environmental parameter	Maximum value	Unit of measurement
hydrofluoric acid	0,001	mg/m^3
	0,0012	cm^3/m^3
ammonia	0,03	mg/m^3
	0,042	cm^3/m^3
ozone	0,004	mg/m^3
	0,002	cm^3/m^3
nitrogen oxide	0,01	mg/m^3
	0,005	cm^3/m^3

Table 2

2.3 RESISTANCE TO VIBRATIONS

As regards vibrations, the Unit has the following limitations:

10Hz ≤ frequency ≤ 57Hz	0.075	mm (width)
57Hz ≤ frequency ≤ 150Hz	1	g

Table 3

If vibration levels exceed the above values, proper vibration damping measures should be considered.

2.4 PROTECTION AND POLLUTION DEGREE

Protection degree	IP20 (1)
Pollution degree	2 (2)

Table 4

(1) With suitable protections on input and output bars
(2) Non-conductive pollution and – occasionally and temporarily - conductive pollution generated by condensation.

2.5 STORAGE

2.5.1 STORAGE ENVIRONMENTAL CONDITIONS

temperature	-10÷60	°C
humidity	5÷95	%
condensation	NO	

Table 5

2.5.2 RECOVERY PROCEDURE AFTER STORAGE

The drive cannot be used immediately after a storage period. To prevent failures, use the following recovery procedure.

STEP 1:

Non-powered Converter		
temperature	15÷35	°C
humidity	5÷75	%
condensation	NO	
atmospheric pressure	86÷106	kPa
recovery time (1)	1	h

Table 6

(1) After this recovery time, there should be no trace of condensation inside or outside the drive (well-ventilated environment).

STEP 2:
For long storage periods (one or more months), always proceed to regenerate the electrolytic capacitors of the power BUS. Leave the converter powered through the + and – terminals for 30min to 1hour, without deriving power from the DC Bus generator.

Once the regeneration process has been completed, the converter can work normally.

3 INSTALLATION INSTRUCTIONS

3.1 INSTALLATION

The Braking Unit (BRU) should always be installed in places meeting the environmental requirements in Chapter “Use Limitations”.
Moreover, all control and display devices should be easily accessible at all times.

Any other equipment must be installed at a reasonable distance from the drive, in order to prevent any metal residues from drilling operations or from metal cables from falling into the drive. Under no circumstances can the converter be mounted near easily flammable material. Figure 1 shows the minimum clearances required to ensure proper cooling of the power part.

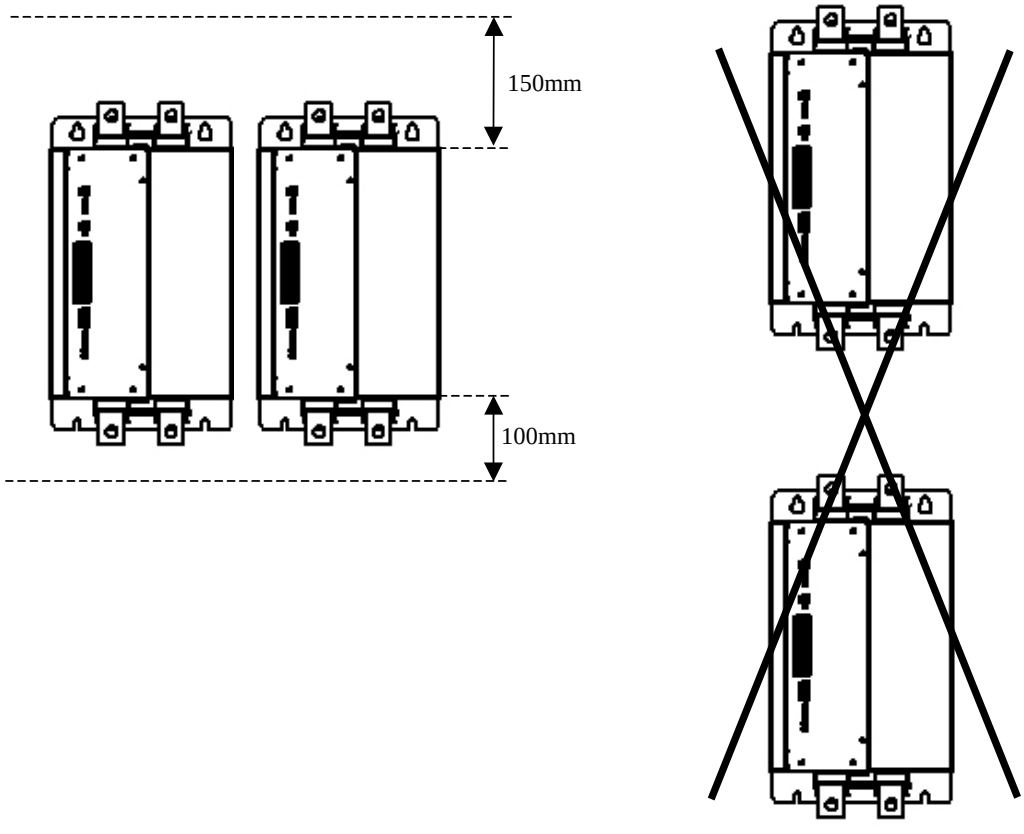
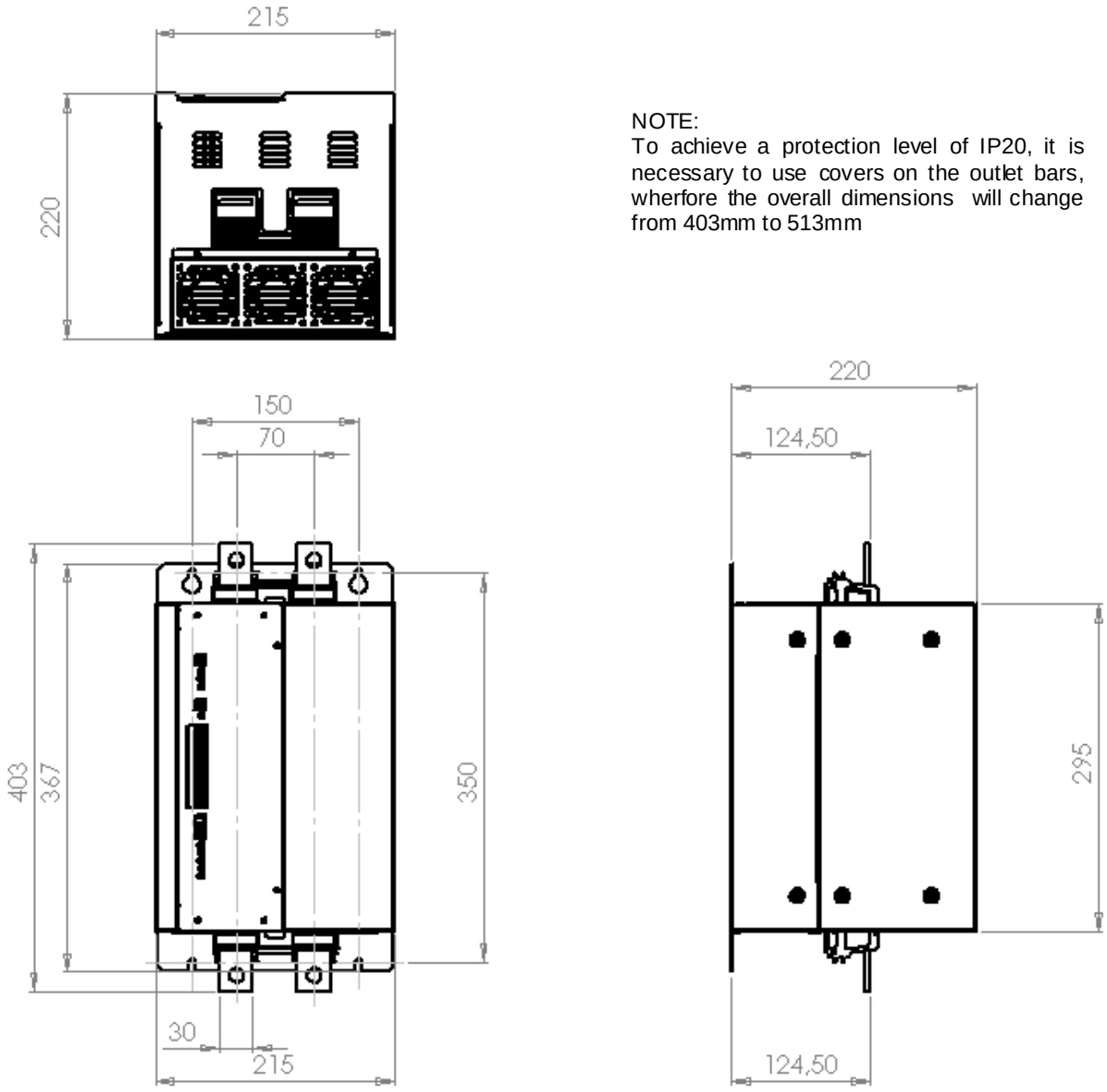


Figure 1

NOTE: Use four M6 screws to fix the Braking Unit to the cabinet panel.

3.2 MECHANICAL DIMENSIONS



NOTE:
To achieve a protection level of IP20, it is necessary to use covers on the outlet bars, wherfore the overall dimensions will change from 403mm to 513mm

Figure 2

3.3 CONFINED SPACE: POWER LOSS

The table below shows the total power loss of a Braking Unit when it is operating at its rated current, including losses due to regulation and ventilation. If the Braking Unit is installed in a confined space, such as a cabinet, make sure that the temperature inside the cabinet does not exceed the maximum ambient temperature allowed for the Braking Unit. If needed, provide sufficient air ventilation to remove the heat generated by the Braking Unit and other components.

Size [A]	Total Power Loss [W]
85	170
125	240
250	470

Table 7

3.4 GENERAL FEATURES

Braking Unit Size		85	125	250
Input voltage	[Vdc]	400÷720		
Capacity of the intermediate circuit	[μF]	410	1230	1230
Output thermal current(1)	[Adc]	85	125	250
Output peak current	[Adc]	170	250	500
Brake activation voltage	[Vdc]	680 / 730 /770		
Brake deactivation voltage	[Vdc]	650 /700 /740		

Table 8

NOTE:
(1) 1% derating every 100 m, for altitudes exceeding 1000m above sea level.

4 POWER PART

4.1 POWER CIRCUIT

The power diagram of the Braking Unit (figure 3) consists of the following:
- Brake IGBT for dissipating the power fed back to the power BUS by the converters
- Capacity on the intermediate stage
- Switching mode power supply for generating the power required by the internal logic and the cooling fans

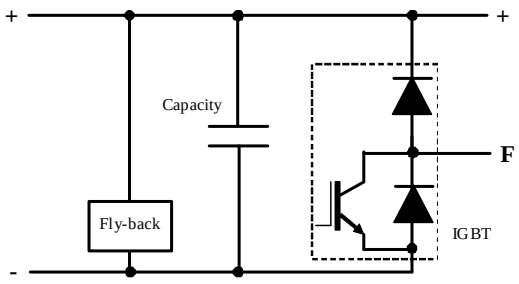
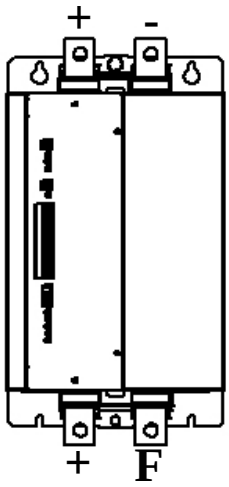


Figure 3

4.2 DESCRIPTION OF THE POWER TERMINALS

Table 9 contains a description of the power terminals (power bars) and their meaning.



Power supply input side (top)	
Terminal	**Description**
+	Power BUS positive terminal
-	Power BUS negative terminal

Braking resistor wiring side (bottom)	
Terminal	**Description**
+	Power BUS positive terminal to be used **solely** for wiring the braking resistor
F	Brake IGBT Collector to be used for wiring the braking resistor

Table 9

4.3 WIRING THE POWER PART

Figure 4 shows the power connection for the Braking Unit. The fuses and cables to be used are detailed in section *4.4 Power Components*.
WARNING: When several Braking Units are used (in case of master slave operation, or of several Braking Units controlled by a smart unit) each Braking Unit must have its own braking resistor. In fact, the outputs of two or more Braking Units **MAY NOT** be connected in parallel.

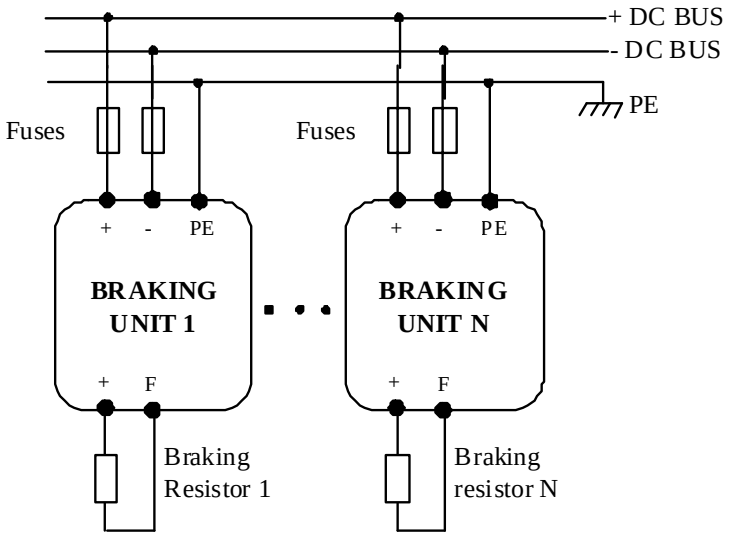


Figure 4

4.4 POWER COMPONENTS

Table 10 contains a list of the power components that are recommended to ensure proper operation of the Braking Unit. The fuses indicated are used to protect wiring to the Braking Unit.

Size	Ultrafast fuses for cable protection (PVC) @ Tambient=40°C				Wiring cable section	
	Nominal current rating	I^2T fuses < I^2T cable @5s	Minimum short-circuit current	Fuse voltage	Section of + , - , + , F cables	Section of GROUND cable
[A]	[A]	[KA^2s]	[A]	[Vac]	[mm^2]	[mm^2]
85	160-450	<16200	1800	690	35	25
125	200-630	<33062	2571	690	50	35
250	400-1250	<190440	6172	690	120	70

Table 10

Table 11 indicates the minimum values of the external braking resistors as a function of the activation voltage of the braking circuit itself. This table also shows the maximum thermal capacities and maximum peak capacities at the minimum resistance value of the braking resistor.

Size	Minimum value of braking resistor			Maximum thermal capacity at minimum resistance			Maximum peak capacity at minimum resistance		
	680V	730V	770V	680V	730V	770V	680V	730V	770V
[A]	[Ω]	[Ω]	[Ω]	[KW]	[KW]	[KW]	[KW]	[KW]	[KW]
85	4	4,3	4,5	57,8	62,1	65,5	115,6	124,1	130,9
125	2,7	2,9	3,1	85,0	91,3	96,3	170,0	182,5	192,5
250	1,4	1,45	1,54	170,0	182,5	192,5	340,0	365,0	385,0

Table 11

5 CONTROL PART

5.1 DESCRIPTION OF THE TERMINAL BLOCK

Table 12 provides the details for the control terminal block and fiber optics.

Terminal	Description	
M1-1	+24VOUT	Output auxiliary voltage 21.6÷26.5V as referred to 0POUT. Maximum output current 100mA.
M1-2	0POUT	+24VOUT auxiliary voltage common.
M1-3	BRAKE EN.	Logic input. Enables the braking circuit. This input is optoisolated from the internal regulation and is referred to 0V BR EN. (M1-4). This logic input is in parallel with the brake activation command supplied via fiber optics (BRAKE EN.) and with the command that is generated internally (when the slave function is disabled). Input voltage range 21.6÷26.5V, absorbed current 10mA.
M1-4	0V BR EN.	BRAKE EN. (M1-3) logic input common.
M1-5	L.O.1	Logic output for activating the braking circuit.
M1-6	/L.O.1	This logic output is optoisolated from the internal regulation. The transistor is conductive when this output is active. Imax=60mA, Vmax=30V
M1-7	L.O.2	Pre-alarm logic input: the radiator temperature is approaching the alarm threshold.
M1-8	/L.O.2	This logic output is optoisolated from the internal regulation. The transistor is conductive when this output is active. Imax=60mA, Vmax=30V
M1-9	DR OK N.O.	DRIVE OK logic output
M1-10	DR OK COM	Clean contact relay (energised under normal operating conditions)
M1-11	DR OK N.C.	Features of the relay: 250VAC 8A. DR OK N.C.
M1-12	0V	Internal regulation common.
M1-13	VBUS	Logic output as referred to 0V (M1-12) and proportional to the BUS voltage (ratio 1:100). Output: +8V / 2mA
M1-14	SHIELD	

FIBRE OPTICS	Description
BRAKE EN.	Logic input. Enables the braking circuit. Light on = braking is active This logic input is in parallel with the brake activation command supplied via terminal M1-3 (BRAKE EN.) and with the command that is generated internally (when the slave function is disabled).
DRIVE OK	DRIVE OK logic output Light on = No alarm present

Table 12

5.2 DESCRIPTION OF THE CONFIGURATION DIP-SWITCHES

On the front panel there are two Dip-switches that enable users to customize their Braking Unit. The first Dip-switch enables the setting of up to three different activation voltages for the braking circuit. By contrast, the second one enables the user to operate the Braking Unit as if it were controlled from outside (that is, as a slave only). Table 13 provides a description of these Dip-switches.

SW1: used to set the brake activation and deactivation thresholds			
SW1-1	**SW1-2**	**Brake activation voltage [Vdc]**	**Brake deactivation voltage [Vdc]**
OFF	OFF	680	650
ON	OFF	730	700
OFF	ON	770	740
ON	ON	770	740

SW2: used to set the unit for slave operation		
SW2-1	**SW2-2**	**Description**
OFF	X	The internal brake activation circuit, which goes in parallel with the brake activation commands supplied via logic inputs (terminal M1-3 or fiber optics BRAKE EN.), is on.
ON	X	The brake activation command is supplied *solely and exclusively* via logic inputs (terminal M1-3 or fiber optics BRAKE EN.) The Braking Unit operates as a SLAVE.

Table 13

5.3 DESCRIPTION OF SIGNALLING LEDS

On the front panel of the Braking Unit there are some signalling leds. They allow the users to check the configuration of the Unit itself and provide immediate troubleshooting information in case of an alarm.
Their meaning is shown in Table 14

Signalling leds	
Name	**Description**
680V	Brake activation voltage is set to 680Vdc (when this led is on).
730V	Brake activation voltage is set to 730Vdc (when this led is on).
770V	Brake activation voltage is set to 770Vdc (when this led is on).
SLAVE	Operation as a SLAVE: the brake activation command is supplied *solely and exclusively* via logic inputs (terminal M1-3 or fiber optics BRAKE EN.) (steady on = operation as a SLAVE)
DRIVE OK	This led indicates that the drive is ready (steady on = OK)
MAX VOLT	DC BUS overvoltage alarm (led on = alarm).
MIN VOLT	DC BUS undervoltage alarm (led on = alarm).
OVER TEMP	Heat sink overtemperature alarm (led on = alarm).
POWER FAULT	Brake IGBT power fault alarm (led on = alarm).

Table 14

5.4 EXAMPLES OF SIGNAL CONNECTIONS

5.4.1 Wiring as Stand Alone Unit

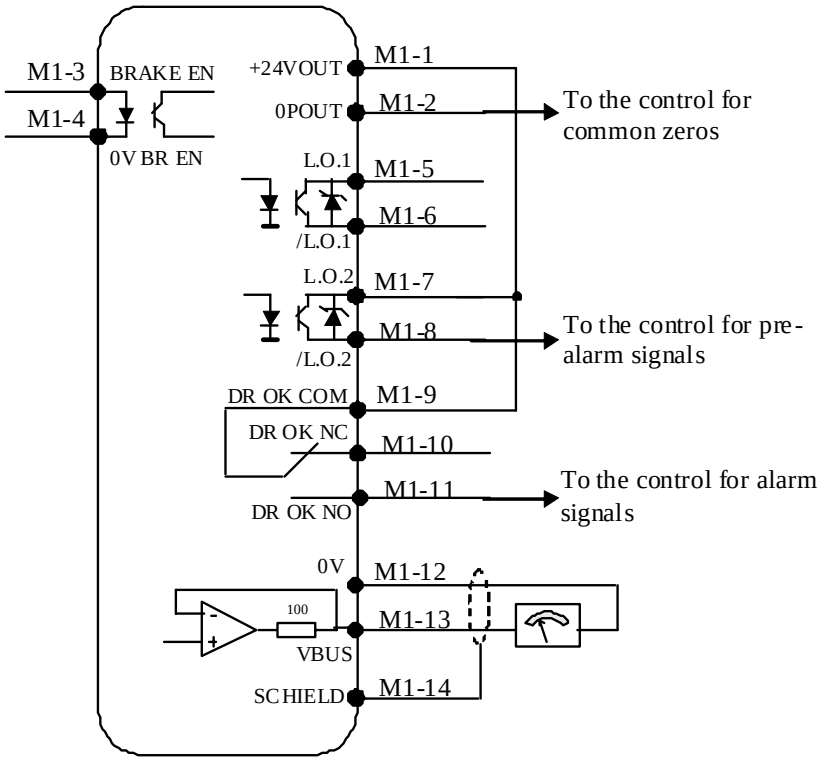


Figure 5

The “brake enable” command is generated internally. The logic outputs and analog signal are used merely for diagnostic purposes (troubleshooting).

5.4.2 Wiring for Master – Slave Operation

In the diagram below, the “Master” supplies the brake activation command to the slave via the L.O.1 logic output. If you wish to set up the second Braking Unit as a slave, follow the instructions provided in section *5.2 Description of the Configuration DIP-SWITCHES*.

The series of the two DRIVE OK clean contacts is wired to the control for diagnostic purposes. You can also use the series of L.O.2 logic outputs for the purpose of recognizing any pre-alarm condition on one of the two Braking Units.

Finally, you can also use a master-slave configuration with several slaves. All you have to do is connect the L.O.1 logic output of the master to all BRAKE EN inputs (the 0POUT of the master must be connected in common to the 0V BR EN of the slaves). All DRIVE OK contacts must be placed in series, so as to send any alarms to the control.

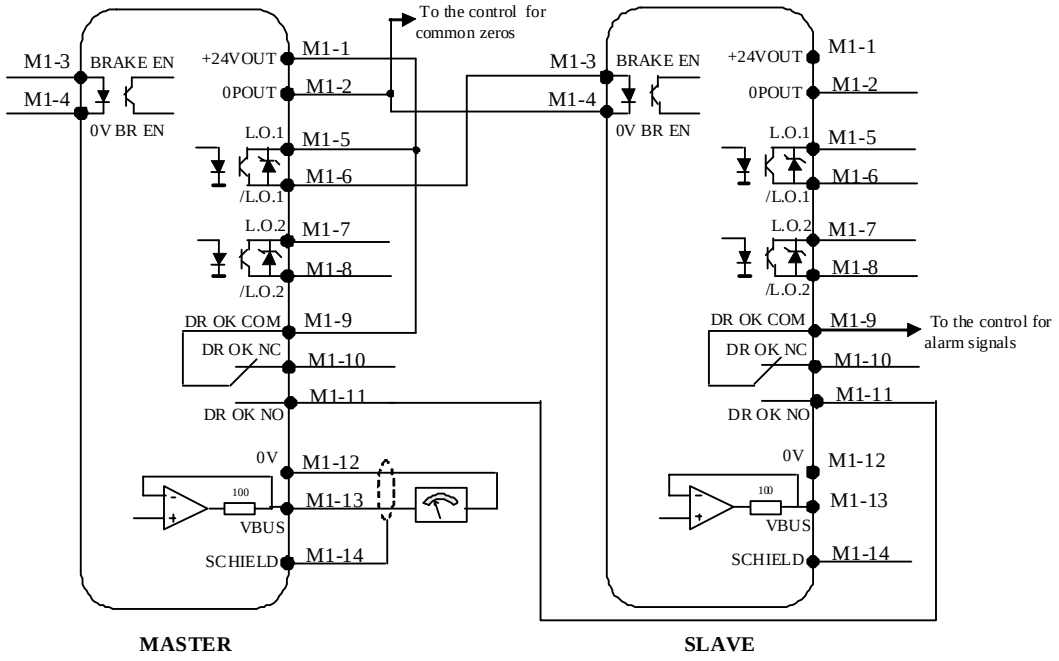


Figure 6

5.4.3 Wiring for Slave Operation

This Braking Unit can be configured to operate as a slave and to receive the brake activation command and supply the DRIVE OK signal to a smart unit, via fiber optics. The smart unit can receive the signal proportional to the power BUS voltage from the Braking Unit itself. The wiring diagram to be used in this case is shown in the following figure.

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